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THE CANAL ELECTROMETER

A. INTRODUCTION

The canal electrometer is a health instrument in that it was designed by the Health-Physics Section and is being used to accomplish what formerly was a radiation hazardous job, without any radiation exposure.

During early operations at W, the radiation intensity of a slug was determined by placing the slug on the far wall of the canal by means of long tongs and measuring its intensity with a Lauritsen electroscope located at a distance of 7 to 10 feet from the slug. The operators had to work in a field of several hundred mr/hr during this measurement and if a number of slugs were to be measured the operation presented a potential radiation hazard. The canal electrometer has eliminated this source of radiation exposure by making it possible to calibrate slugs under about 6 ft. of water. The operation is not only done safely but it is accomplished much more quickly and accurately than by the early procedure.

There are no new principles involved in the design of the canal electrometer. It consists simply of an ionization chamber feeding a Lindemann electrometer, with a high resistance leak connected across the input so that the meter becomes the direct reading type. This effort to describe the canal electrometer is considered worthwhile because:

1. It is a good illustration of how a simple application of old instrument principles can provide a practicable and very useful measuring device. It is believed that the canal electrometer is capable of accomplishing what otherwise would require a rather complicated (and perhaps not as consistently reliable) electronic circuit.
2. It serves as an instrument record of the construction, calibration and use of this instrument.
3. It suggests that this instrument can be used in other operations when it is desirable to measure radiation intensities ranging from a few mr/hr to a few hundred thousand mr/hr. It is believed by the writer that this instrument is capable of providing the simplest and most accurate method of determining the radiation level in the cells of the fission separation buildings (706-C and 706-D) and in other very hot areas. Until recently the

greatest single problem in the way of more general use of this instrument principle was to obtain a sufficient number of Lindemann electrometers. Recently the new Ryerson electrometer has been developed at Chicago and it has proved to be superior even to the Lindemann. It is expected that this new electrometer can be produced in sufficient quantity to remove the difficulty in procurement.

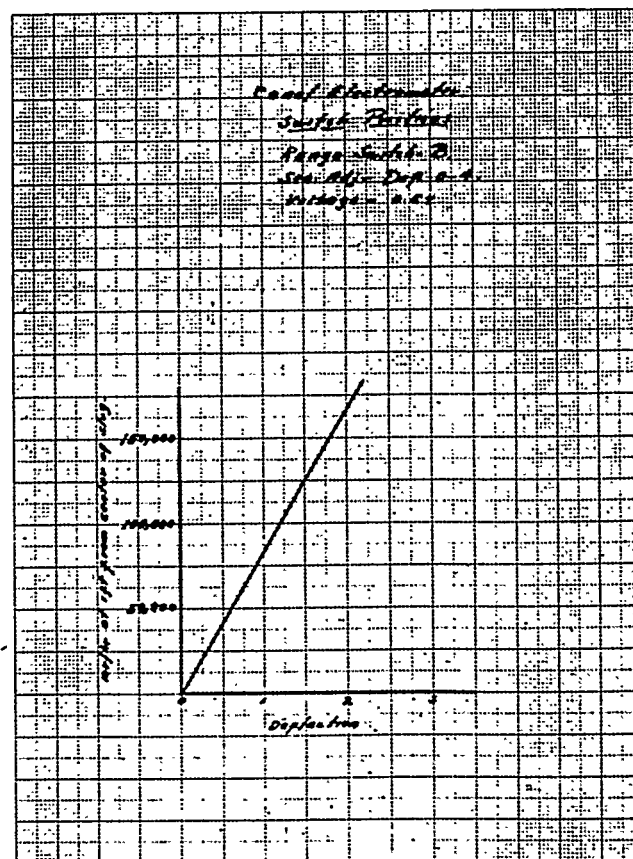
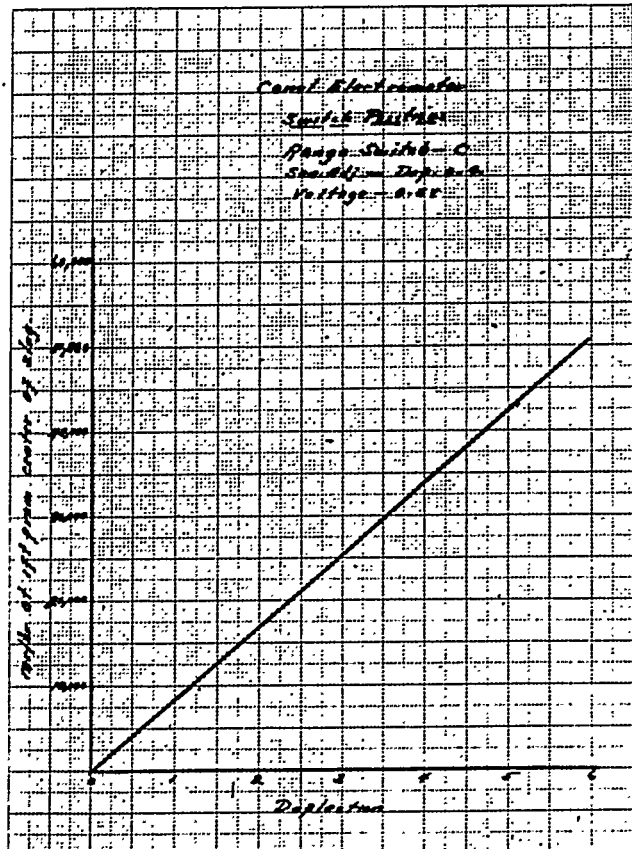
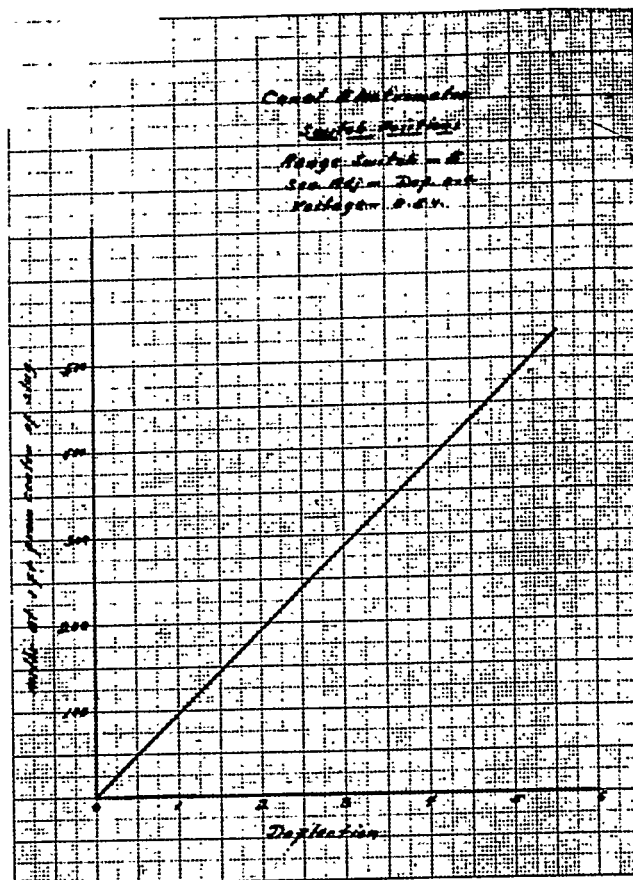
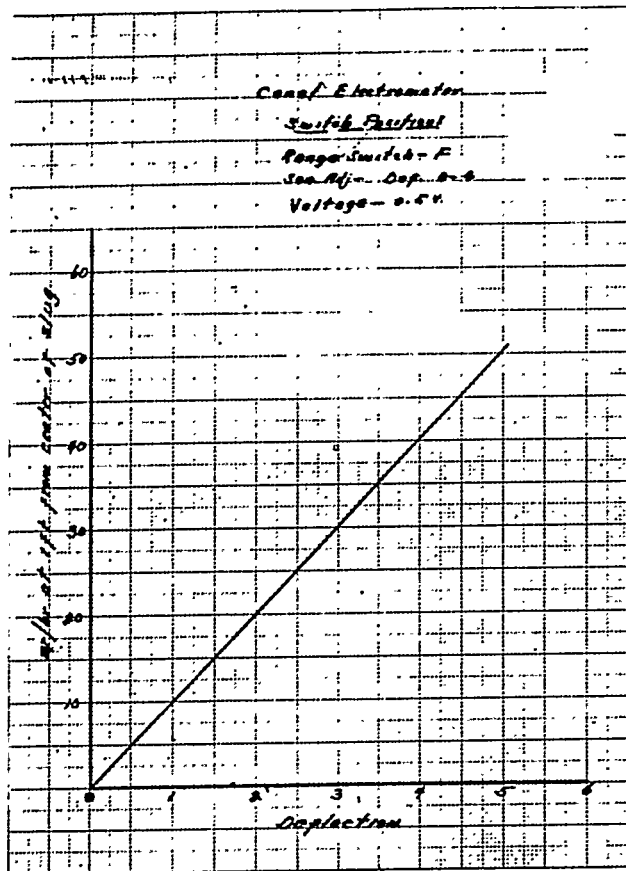
B. DESCRIPTION

The canal electrometer was designed by K. Z. Morgan of the Health-Physics Section at the instigation of H. M. Parker, and was constructed under the supervision of J. R. Brand of the Instrument Section at Clinton Laboratories. The details of the circuit are shown in Figure 1. This unit is in three principle parts as can be seen by the photographs:

1. Ionization Chamber
2. Electrometer Box
3. Battery Box

1. Ionization Chamber. The details of the ionization chamber are indicated in Figure 2. The chamber has a collecting volume of ~ 4.5 cubic inches and is maintained at atmospheric pressure. The chamber (a) is held in place and insulated electrically by the bakelite chamber (b) which surrounds it and is fastened to the wall of (c) by means of screws. The central electrode of the chamber is an extension of the conducting system (c). The conducting system (c) is evacuated to prevent its behaving as an ionization chamber (considerable ions could be collected even though the side walls are at ground potential) and to reduce electrical capacity and electrical leakage. The vacuum is provided by an oil pump. The ionization chamber (a) and conducting system (c) are protected from the water by a surrounding stainless steel pipe. The conducting system (c) is 12 ft. long and is enclosed in the stainless steel pipe which extends into the canal water at an angle of $\sim 45^\circ$. A slug holder consisting of a short half section of pipe is welded on top of this stainless steel pipe just above the ionization chamber.
2. Electrometer Box. The electrometer box is an 8" steel pipe with a removable gasketed cover over the rear end. The front part of the 8" pipe is cut diagonally to give the front edge an elliptical shape so that the top part of the pipe can serve as a light shade for the plastic cover underneath. The plastic cover contains a ruled scale on its upper part on which the image of the electrometer fiber is projected. This plastic cover is fastened in place and held tightly against a gasket by means of screws. The space behind the plastic cover is air tight and at atmospheric pressure.

BATTERY BOX



This instrument has been in operation about a year at this writing and has given very reliable service. It has maintained the same calibration over this period of time and has not required any maintenance or repair.

D. OPERATION INSTRUCTIONS FOR THE CANAL ELECTROMETER.

The Sen. Adj. should be on 11 (open circuit) when set is not in use. Turn the A.C. switch on the battery box to ON and allow the electrometer to stand about 10 minutes to warm up, (or leave the A.C. switch ON all the time). Note the mechanical zero. Turn the D.C. switch on the battery box ON.

After the set has had time to warm up, throw the light switch to Elect. and turn the Sen. Adj. switch to position 3. Turn the Range switch on the side of the electrometer to position G (open circuit). Now adjust the Elect. Zero so that the electrical zero coincides with the mechanical zero, i.e., adjust Elect. Zero to bring the fiber to the mechanical zero. With the chamber switch at OFF position, the voltage switch on 0.5 V and the Cal. switch at ON position, adjust the Sen. Fine. Adj. and Elect. Zero until the fiber swings from four divisions beyond the mechanical zero to the mechanical zero on operation of the Cal. Switch from ON to GND. (It may be necessary to place the Sen. Adj. switch on some position other than 3 in order to obtain four divisions deflection if the 67.5 battery voltage is low.

When this calibration has been made, throw the Cal. switch to the Gnd. position (the fiber should be on the mechanical zero). The electrometer is now ready for operation. Turn the range switch to point B and place the slug to be measured in position. Throw Chamber-switch to ON position (this lifts the relay plunger in Figure 1) and adjust the Range switch until a conveniently readable deflection of the fiber is obtained. Refer to the calibration chart for the Range switch position (B, C, D, etc) used and obtain the radiation in mr/hr at 1 ft. from the center of the slug.

When the reading is complete return the Chamber switch to OFF and Range switch to point B. The electrometer is now set for a new reading.

When the electrometer is not in use the Sen. Adj. switch should be at point 11, Chamber switch at OFF, D.C. switch on OFF and the Cal. switch on Gnd. The A. C. switch may be left ON with the Light switch on Pilot.

